The effect of small-molecule bio-relevant organic components at low concentration on the corrosion of commercially pure Mg and Mg-0.8Ca alloy: An overall perspective

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After years of research and development, magnesium and its alloys have become a promising biodegradable implant material for bone and cardiovascular applications. For a biodegradable material, understanding its degradation mechanism and degradation rate are of paramount importance. A few published works have presented the influence of inorganic ions on the corrosion of magnesium in simulated body fluids [1, 2]. However, the individual effect of the small-molecule bio-relevant organic compounds, like amino acids, vitamins, saccharides and antibiotics, on the corrosion of magnesium have not been investigated systematically.

In this study, 53 bio-relevant organic compounds constituting plasma/serum or cell culture media were selected as research objects. The hydrogen evolution tests were performed to investigate the influence of these organic components on the corrosion of magnesium. The individual and combined influence of group of amino acids was revealed, as well as the group of vitamins and saccharides. The influence of penicillin and streptomycin at different concentration on the corrosion of magnesium in MEM was also discussed.

We found that the small-molecule organic components do not have a critical influence on the corrosion of magnesium in vitro. In general, the individual influence of tested compounds at low concentration is not significant in NaCl solution. Neither the combined effect of several amino acids, vitamins and saccharides in SBF is significant. It is noteworthy that, different magnesium alloys were found to have similar corrosion behavior in same medium (SBF or MEM) whereas their corrosion rate was significantly different when tested in 0.85% NaCl solution. Similar corrosion behavior of the same alloy in SBF and MEM was also observed. These phenomena indicate that the corrosion of Mg in simulate body fluids (such as SBF, HBSS or MEM) are dominated by the precipitation/conversion of corrosion products which is mainly controlled by inorganic components of the electrolyte.

Keywords: Magnesium; Corrosion; Degradation; Small-molecule organic components;

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